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MENTAL AND MUSCULAR WORK

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THOSE who have had the opportunity of observing the results of muscular and mental effort have often noted a coincidence between the ability of a pupil to perform gymnastic feats and his proficiency in theoretical studies; and the generalization has been made that there is an intimate relationship between muscular and mental power. For a study of this relationship the power of grip ("strength of forearm" as it has been called) as recorded by the spring dynamometer, of seventy-five young women of one class of the New Haven Normal School of Gymnastics, was compared with the marks received (average of two examinations) in the study of human anatomy. The slight similarity between the results of these tests for muscular and mental effort was so apparent, when the marks were down on paper, that a comparison by groups alone seemed worth while. The grouping was made according as the pupils received a mark of 90 or more, 80 to 89, 70 to 79, and 69 or less in anatomy, the largest number of the class (thirty-eight) falling into the third group.

The average of the strength tests for each group was: for the 90 or more, 37 kg.; for the 80 to 89, 35 kg.; for the 70 to 79, 31 kg.; and for those below 70, 35.5 kg. The lowest strength record, 22 kg., was made by a pupil who received an anatomy mark of 75. The greatest display of strength, 49 kg., was exhibited by two members of the class, one of whom received an examination mark of 91 and the other 80. One of these with an anatomy mark of over 90 gave a strength test of only 30. The lowest strength test given by those who attained over 90 was 30 kg., and the same grip was the lowest exerted by those who did not reach above 69.

From such figures and such means of comparison, there is (on the strength plane represented by a grip of 22 kg. or more) evidently very slight connection between the results of mental and muscular effort. However, the markings for anatomy represent prolonged mental effort, while the display of muscular force upon a dynamometer does not indicate the possible power for continued muscular exertion. There might be a closer relationship between mental marks and tests for prolonged muscular work. As a simple measure of the endurance of the pupils they were asked to hold one arm in the abducted horizontal position as long as possible. The variation in the results of this test was far wider than that for the brief display of muscular force, and there was little correspondence between the strength and endurance tests of each individual. One young lady who gripped with a force of 49 kg. held her arm out for only three minutes and 45 seconds, while another, whose grip was but 22, kept her arm raised for seventeen minutes.

Individually again there was no relation between muscular and mental endurance, if we can so speak, only one of those receiving a mark of over 90 showing muscular endurance of more than 10 minutes, while one who received 66 held her arm out for 95 minutes, and one who had a mark of 70 made an unfinished record of 121 minutes.

The wide variation in the powers of endurance as shown by this test are of much physiologic interest. Two of the tests were incomplete, owing to lack of time. One of these young women felt no fatigue at the end of an hour, nor the other at the end of two hours. A similar wide variation was shown in the tests made by Prof. Irving Fisher,[1] in which both arms were held horizontally, from a minimum of six to a maximum of two hundred minutes. In the latter tests, flesh-eaters attained an average record of only twenty-two minutes and there seemed to be some proof that the vegetarians in the contest had superior powers of endurance. All members of the group tested in the normal school were flesh-eaters, most of them ate at the same table, and all had received for months the same muscular training. These endurance tests were taken without class competition.

In addition to the above tests and comparison, a similar endurance test was taken of eighty-six freshmen boys in the high school, near the end of the school year. A rough average of the marks for the year in all mental branches was made, using the system of grading of the school. Those having an average of over 90 falling in grade A, between 75 and 90 in grade B, between 60 and 75 in grade C. The endurance test was taken in class and was limited to twenty minutes. While many would have held out longer, the general result would probably have been much the same, for the Class A pupils gave an average of 12⅓ minutes, the Class B 16 minutes plus, and Class C 13.9 minutes. The high-school boys did not therefore exhibit any more connection between mental and muscular powers than did the normal-school girls. Not even does the superior ambition which is presumed to impel to mental superiority seem to have any effect in adding to the prolongation of neuro-muscular effort of those of high scholarship.

From the results of such uncertain means of measurement the variability in powers of muscular exertion and especially of prolonged muscular work, are evidently as great as for mental effort, or, more accurately stated, the neuro-muscular quality of prolonged effort is as variable as the cerebral qualities involved in acquiring and expressing an orderly collection of facts on a given subject. The wideness in variation of the neuro-muscular quality among those who have for a considerable time been subject to the same diet and the same gymnastic and athletic exercises shows that the quality is innate and subject to little modification by training. A like inherent power for grasping a subject must have been noted by all teachers of mental work and the discouragingly slight change in quality of such work brought about by the efforts of the teacher is also familiar.

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[1] "The Influence of Flesh-Eating on Endurance," Irving Fisher, Ph.D., *Yale Medical Journal,* March, 1907.

While such a comparison of tests would seem to show that there is little connection between exercise of the mind in school work and the exercise of the muscles in strength and endurance tests, it does not follow that the results of mental work carried on through one's own initiative may not correspond more nearly with one's power of muscular endurance, nor does it signify that mental superiority, and that complex which we call health, have no intimate connection. As Emerson said, "For performance of great work it needs extraordinary health." "When nature goes to create a great man she puts a symmetry between the physical and intellectual powers." The man of genius certainly has, as a rule, been a man of most unusual bodily powers. Napoleon, up to the time he became emperor, knew no such thing as fatigue. He said of himself that he had "the constitution of an ox." Tolstoi, at the age of fifty-eight, walked 130 miles in three days without fatigue. Porson, the great Greek scholar, frequently walked 52 miles to his club. Walter Scott was a supremely healthy man who could walk thirty miles a day. Samuel Johnson, Goethe, Humboldt, Wordsworth, Tennyson, Browning, Brahms, Beethoven, Wesley, Beecher, Gibbon, Washington, Lincoln, are but a few examples of men of genius who showed great bodily powers. There are exceptions to the rule, though these were none the greater for being exceptional. Even geniuses of slight physique, such as DeQuincy and Charles Lamb, were tireless walkers, Poe was athletic before he was overcome by alcohol, and even Stevenson showed unusual muscular powers for so sickly a person. Doubtless walking would be a far better test of endurance than the mere extending of the arms. As for strength tests, we know that Franklin astonished his printer companions by carrying two forms of type to their one; that Tolstoi could lift a hundred and eighty pounds with one hand, and that Walter Scott as a young man "could lift a smith's anvil with one hand, by what is called the horn." Scott does not give the weight of the anvil, but the feat was evidently an extraordinary one. Lincoln, it is said, could lift three times as heavy a weight as any common man. None of these men (unless it was Tolstoi) underwent any systematic "physical training" and the muscular powers they exhibited were either inborn, or developed along with the extraordinary exercise of their mental machinery. We do not know what relationship the ideational bear to the motor regions of the brain, but the exercise of the former must bring to the latter a blood supply which they would not otherwise receive, and these batteries, from which muscular activities are originated, might be the larger and more powerful for such association.

Though the foregoing figures do not prove, they do not disprove that the combination of a superior showing in muscular strength or endurance with superior showing in mental effort makes (other things being equal) for the best prospect for future accomplishment. Chief among the "other things" are ambition and the incentive of material needs. Poverty, or the fear of poverty, is a better soil for genius than prosperous surroundings. Much of the world's choicest production, in art or literature, would never have existed had bread and butter been forthcoming without work.

The results of these tests are of more use in what they do not prove than in what they prove. They are suggestive especially of the complexity of the matter examined and the questionableness of the value of such tests of either muscular or mental effort. The successful application of the mental machinery to routine school work depends upon heredity and extra-educational conditions, the brain being, with the same perfection of bodily backing, easily set to work upon scholarly pursuits in the one case, while in another case these are as foreign as the weaving of silk to a threshing machine. The man of genius toils joyously where the average student works without interest as well as without fitness for his task. Even the man of genius, as Boileau, Rousseau or Goldsmith, has sometimes seemed a dunce in his work at school.

The great variation in the results of these tests of strength and endurance emphasizes the fact (well enough known but often overlooked) that these, like mental qualities, are inborn, are not to be created by any form of training, and that, given the opportunity, they will develop to near their maximum. Muscular or mental training furnishes only an aid to completest development and maintenance of these powers. In systematic gymnastic, manual, and other forms of physical training there is combined training of both muscular and mental faculty. Unless muscular exercise is overdone it helps to maintain health and so to keep the mental powers at their best. A DeQuincy may feel the need of a walk of at least fourteen miles a day. An Edwin Booth or a Lord Lyons may find himself as well off with a minimum of muscular effort. The remark of Emerson, after his experience in gardening for health (into which he was inveigled by the enthusiastic counsel of Thoreau), is significant. He wrote:

> If I judge from my own experience I should unsay all my fine things, I fear, concerning the manual labor of literary men. . . . To be sure he may work in the garden, but his stay there must be measured, not by the needs of the garden, but of the study.
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> When the terrestrial corn, beets, onions and tomatoes flourish, the celestial archetypes do not.[2]

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[2] The writer is much indebted to Miss Nina A. Dudley, of the New Haven Normal School of Gymnastics, and to Mr. Rufus A. Spencer, of the New Haven High School, for directing the tests here described.